A HEATING DEVICE FOR A FEEDING BOTTLE

The present invention relates to a device suitable for use with, but not exclusively, an infant's feeding bottle, for heating a flow of liquid at storage temperature, passing through the device, to a temperature acceptable for drinking by an infant. The invention also relates to a drinking vessel, particularly an infant's feeding bottle.

The methods presently used for heating pre-prepared liquid drinks or feeds for an infant, such as heating in a microwave; standing in a pan of boiling water; or conventional baby bottle warmer have a number of disadvantages; the need for an external heat and power source is often an inconvenience, for example when the baby requires feeding away from home; overheating the liquid can occur, requiring the liquid to be cooled or discarded; the temperature of the liquid will reduce as the baby feeds, possibly dropping below the temperature the infant finds acceptable for feeding; heating the liquid takes time, if the baby is hungry this can lead to the baby becoming stressed.

These methods of heating have a further disadvantage in that they require heating the entire volume of liquid that has been pre-prepared; as the quantity of liquid the baby is likely to drink is unpredictable and some liquids, such as milk particularly breast milk, are not suitable for repeated reheating, unfinished liquid may need to be discarded.

It is an object of the present invention to avoid or minimise one or more of the above disadvantages.

The present invention provides a heating device, adapted for use with a drinking vessel suitable for containing a fluid, for example an infant's feeding bottle, the device including:

means for releasably connecting the device to a said vessel, so as to be in fluid communication therewith;
inlet means for receiving, in use, a flow of fluid from a vessel;
outlet means, for allowing, in use, a flow of fluid to leave the device, the outlet means being in fluid communication with the inlet means; and
means for heating a fluid, in use of the device, as it flows between the inlet means and outlet means;
whereby, in use, a flow of fluid from a vessel flows through the device from the inlet means to the outlet means and leaves the device through the outlet means at an elevated temperature.

Preferably the device further includes non-return means for, in use, preventing fluid that has passed through the inlet means from returning to the vessel. Desirably there is provided a non-return means on the outlet means to prevent fluid returning and coming into contact with the heating means.

The present invention provides, in a second aspect, a drinking system for an infant, to provide an infant with a liquid feed at an acceptable consumption temperature, the feeding system including:
a vessel suitable, in use, for storing a liquid feed at a storage temperature; and

a device for, in use, elevating the temperature of a liquid feed from the storage temperature to an acceptable consumption temperature, the device including:
means for connecting the device to the vessel, so as to be in fluid communication therewith,
inlet means for receiving, in use, a liquid feed from a vessel,
outlet means, in fluid communication with the inlet means, for allowing a liquid feed, in use, to pass to the infant; and
means for heating a liquid feed, in use of the system, as it flows between the inlet means and outlet means;
whereby, in use, the liquid feed is drawn from the vessel, through the device, to an infant, and the temperature of the liquid feed is elevated as it passes between the inlet means and outlet means of the device, from the storage temperature to an acceptable feeding temperature.

Preferably the feeding system further includes non-return means formed and arranged to prevent fluid that has passed through the inlet means from returning to the vessel. Desirably there is provided a non-return means on the outlet means to prevent fluid returning and coming into contact with the heating means.

The connection means may be a threaded connection, alternatively, it may be a push fit or other suitable connection.

The vessel may be a re-usable infant's plastic feeding bottle, or, alternatively, it may be some form of disposable bottle or a carton with (or without) pre-packaged liquid.

The inlet means may be an opening in the device.

The outlet means may be a mouthpiece, such as a teat, a spout or a straw, alternatively the device also includes means for coupling a mouthpiece, such as a teat, a spout or a straw.

Any suitable means for heating a said flow of fluid as it flows between the inlet means and outlet means may be used and could include a heat exchanger of the shell and tube type, or, alternatively it may be a heater element powered by electricity, such as a heated wire, or heated by an exothermic chemical reaction.

If the heating means requires a power source this may be provided in the form of rechargeable batteries, or alternatively single use batteries.

Preferably the inlet means and outlet means are connected by a heated passageway.

Preferably the inlet means and outlet means are connected by a helical path.

Most preferably the device includes a heated helical path within a heated passageway. Providing a heated helical path through the heated passageway maximises the heated surface area with which the liquid feed makes contact thereby improving the heating efficiency of the device. Advantageously, the heated helical path also controls the flow of liquid through the device, and different configurations of helix will allow for different flow rates of liquid for a given applied suction or force. Conveniently the helical path combined with the heated passageway acts as a static mixer. This will help to ensure the liquid feed

does not contain hot spots or cold spots, i.e. the feed is at a constant temperature.

Preferably the heated helical path is releasably connected to the heated passageway. If the heated helical path is releasably connected to the passageway it may be removed, cleaned and re-used. Alternatively the releasably connectable helical path can be a disposable item.

The heating means may be activated by an on/off switch on the device or alternatively the device may be fitted with a fluid sensor that activates the heating means, in use, when it senses the presence of a flow of fluid between the inlet means and the outlet means.

At least one thermistor may be provided to measure the temperature of the liquid feed in at least one of the inlet, between the inlet and outlet, or at the outlet. These thermistors allow control of the heating elements to ensure the correct temperatures are maintained. The thermistor maybe embedded in the heated sheath and measures the sheath temperature. Preferably the temperature will be limited to a desired or optimum exit temperature. The helix length may be chosen to ensure the liquid reaches said optimum temperature.

A thermostat (or the like) is preferably included so as to ensure the temperature of the feed does not exceed a predetermined temperature.

Preferably the device is provided with a bimetallic strip. The bimetallic strip acts as a failsafe device which will disconnect the power source from the heating means in the event of the device overheating.

Preferably the device includes a tilt switch. A tilt switch may be provided to switch the device off after a set time of being horizontal. A tilt switch may also be used to switch the product on (from a stand-by condition) when the device is picked up.

Preferably the passageway includes a vent. A vent may be provided to prevent a vacuum being formed within the passageway and to ensure a steady flow of liquid through the passageway. There may also be provided a vent into the bottle to allow air in.

Preferably the device is insulated to prevent heat loss.

The non-return means for preventing fluid that has passed through the inlet means from returning to the vessel may be a non-return valve, or, alternatively, the fluid may be prevented from returning by a restriction, which only opens under the action of the infant sucking.

Liquid feed is drawn through the device by the action of an infant sucking on the outlet means, alternatively liquid feed passes through the device due to the effect of gravity.

By virtue of the present invention an infant may be provided with a liquid feed on demand at a temperature acceptable for consumption without needing to first heat the whole body of the liquid feed in a microwave or pan of boiling water, resulting in less wastage of liquid feed and reduced stress for the infant.

Embodiments of the invention will now be described by way of example, with reference to the accompanying drawings in which:

Figure 1 is a partially cut away perspective view of a device suitable for use with an infant's feeding bottle, for heating a flow of liquid according to an embodiment of an aspect of the present invention;

Figure 2 is a cross section taken through plane A-A shown on Figure 1;

Figure 3 is a side view of a feeding system for an infant, to provide an infant with a liquid feed at an acceptable consumption temperature, with the device shown in Fig. 1;

Figure 4 is an exploded view of the feeding system of Figure 3;

Figure 5 is an exploded perspective view of a device suitable for use with an infant's feeding bottle, for heating a flow of liquid according to an alternative embodiment of an aspect of the present invention;

Figure 6 is a cross-section taken through plane A-A shown on Figure 5 of the device when assembled;

Figure 7(a) is a side view of the non-return valve of Figure 6 slightly open;

Figure 7(b) is a side view of the non-return valve of Figure 7(a) in a closed position;

Figure 7(c) is a rear view of the non-return valve of Figure 7(b); and

Figure 8 is a perspective view of a feeding system for an infant to provide an infant with a liquid feed at an acceptable consumption temperature incorporating the device shown in Figures 5 and 6.

Referring to Figures 1 and 2, there is shown a partially cut away perspective view of a heating device suitable for use with an infant's feeding bottle, generally indicated by reference numeral 10, for heating a flow of liquid (Figure 1) and a cross section taken through plane A-A shown on Figure 2. The device includes a screw thread portion 12 for coupling

the device to a vessel (not shown), an inlet 14 for receiving a flow of fluid from a vessel and an outlet 16 for allowing a flow of fluid to leave the device. The heating device 10 also includes heater elements 18 to elevate the temperature of a flow of fluid passing between the inlet 14 and the outlet 16. The heater elements 18 are powered by a rechargeable battery 20 mounted within the device. A second threaded portion 22 is also provided to allow a teat (not shown) to be coupled to the device. The device also includes a non-return valve, in the form of a flap 24 to prevent fluid that has passed through the inlet 14 from returning to the vessel.

Referring to Figure 3, there is shown a side view of a feeding system, generally indicated by reference numeral 30, for an infant, to provide an infant with a liquid feed at an acceptable consumption temperature, with the device for heating a flow of liquid shown in cross section. The feeding system (shown in an inclined orientation) includes a vessel 38, with a base 68, containing a liquid feed 50 at storage temperature, a heating device 36 for elevating the temperature of the liquid feed 50 from the storage temperature to an acceptable consumption temperature, a teat 32 and a collar 34 to couple the device 36 with the teat 32.

The device includes a threaded portion for releasably coupling 52 the device 36 to the vessel 38, an inlet 54 for receiving the liquid feed 50 from the vessel 38, an outlet 56 for allowing the liquid feed to pass to the teat 32. The device also includes a heater element 58 to elevate the temperature of a flow of fluid passing between the inlet 54 and the outlet 56. The heater element 58 is powered by a rechargeable battery 60. A second threaded portion 62 is also provided to allow the teat 32 to be coupled to the

device 36 by the collar 34. The device also includes a non-return, in the form of a flap 64 to prevent fluid that has passed through the inlet 54 from returning to the vessel. With the feeding system shown in an inverted orientation, it will be appreciated that such an orientation, in use, will be common for feeding an infant. The weight of the liquid feed 50 opens the flap 64 and creates a flow of liquid feed 50 through the device 36 to the teat 32. When the feeding system 30 is reverted to a normal upright orientation, allowing it to stand on its base 68, the flap 64 will close preventing any of the heated liquid feed from returning to the liquid feed 50, still at storage temperature, in the vessel 38.

Referring to Figure 4, there is shown is an exploded view of the feeding system of Figure 3, generally indicated by reference numeral 30, for an infant, to provide an infant with a liquid feed at an acceptable consumption temperature. The feeding system includes a teat 32, a collar 34, a device 36 for heating a flow of liquid at storage temperature, passing through the device, to a temperature acceptable for drinking by an infant, and a vessel 38 for storing a liquid feed at a storage temperature. The collar 34 couples the teat 32 to the heating device 36. The heating device 36 includes an on/off switch 40 to activate the heating elements (not shown).

Referring to Figure 5 there is shown an exploded perspective view of a device suitable for use with an infant's feeding bottle generally indicated by reference numeral 110 for heating a flow of liquid and to Figure 6 a cross section taken through plane A-A shown on Figure 5. The device 110 includes a screw thread portion 112 for coupling the device 110 to a vessel (not shown), an inlet 114 for receiving a

flow of liquid from a vessel, and an outlet 116 for allowing a flow of liquid to leave the device 110. The inlet 114 and the outlet 116 are connected by a fixed polymer tube 118 into which a heated sheath 120 is inserted. The heated sheath 120 is heated by means of a wrap around wire type heater 122 and the fixed polymer tube 118 insulates the external surface 121 of the heated sheath 120. Inserted into the heated sheath 120 is a helix 124 made from a highly conductive polymer or a metal coated highly conductive polymer or a ceramic). The helix 124 forms an interference fit with the heated sheath 120 and heat generated in the heated sheath 120 passes by conduction through the helix 124. In use the helix 124 will control the flow of the liquid through the device 110 and, as it is heated, will improve the heating capabilities of the device 110. The helix 124 is removable for cleaning and is reusable.

The helix 124, the heated sheath 120, and the fixed polymer tube 118 are all enclosed within a casing 126, which clips to the screw thread portion 112 and in turn has a screw thread 128 for attaching a conventional infant's teat and threaded teat support (as shown in Figure 8). The casing 126 is also insulated to prevent heat loss from the device 110.

A thermistor 130 is attached to the heated sheath 120 to measure the sheath 120 temperature. This temperature reading is fed back to a PCB 132 which regulates the heated wrap around wires 122. The screw thread portion 112 also includes a thermistor 134 to measure the temperature of the liquid in the vessel (not shown), and the casing 126 includes a further thermistor 136 to measure the temperature of the liquid that has passed through the heated sheath 120. Information from the thermistors 134 and 136 is also passed to the PCB 132, which evaluates the temperatures in each area and can raise

or reduce the temperature of the heated sheath 120 accordingly.

The PCB 132 further includes a bimetallic strip as a safety device to monitor the temperature inside the device 110. In the event of the thermistors 130, 134, 136 malfunctioning and the interior temperature rising to a dangerous level the bimetallic strip will disconnect the heated wires 122 from the battery 140. The battery 140 is rechargeable and is housed with the PCB 132 in the annulus defined by the casing 126 and the fixed polymer tube 118. The battery is recharged by a recharge circuit on the PCB 132, which charges the battery 140 when the device 110 is connected to a mains supply.

The device 110 is activated by pressing an on-off switch 142 and is also provided with an LED 144 which indicates the device 110 is operating.

The LED 144 has the additional benefit of providing some illumination during nighttime feeding of an infant. The device 110 also includes a temperature control dial (not shown) which is linked to the PCB 132 to control the temperature of the liquid feed to allow for user preferences. The helix 124 is held in place by a one way valve 146 (shown in Figure 2) on the inlet 114 and a cap 148 (also shown on Figure 2) on the outlet 116. Additionally the caps serves to hold in the helix. The purpose of the one way valve 146 is to avoid heated liquid returning to the vessel (not shown) from the heated sheath 120. This ensures the unheated liquid in the vessel can be kept at a sufficiently low temperature to stifle bacteria growth and reduce wastage.

Referring to Figures 7(a), (b), (c), which show side and rear views of the non return valve 146, the valve 146 comprises a base 150 and a lid 152, the lid 152 being connected to the base by a hinge 154. The lid 152 will pivot about the hinge 154 under its own weight, so when the device is upright the lid 152 will seal the aperture 156 in the base 150 as shown in Figure 7(b). However, if the device is tilted the lid 152 will pivot away from the base 150 (as shown in Figure 7(a)) thereby opening the aperture 156 and allowing fluid to pass through the aperture 156.

Returning to Figures 5 and 6 the device 110 further includes a tilt switch, which switches the device 110 off after a set time of being vertical.

Referring now to Figure 8, there is shown a perspective view of an infant feeding system to provide an infant with a liquid feed at an acceptable consumption temperature fitted with the heating device 110. It can be seen from Figure 8 that the device 110 has been connected to a vessel 160 using the screw thread portion 112. A teat 162, and a threaded teat support 164 are connected to the casing 126.

Various modifications and improvements may be made to the embodiments hereinbefore described without departing from the scope of the invention.

For example, although the disclosed embodiments use a rechargeable battery as the power source for the heater elements, the skilled man would understand a disposable battery could be used or an alternative power of heat generation such as mains power or an exothermic chemical reaction could be used. Similarly, if a battery is used, it does not necessarily need to be stored in the annulus between

the fixed polymer tube and the casing, the entire infant feeding system could be in the form of a flask with the battery housed in the base section of the flask below the vessel for storing the feed. In this example connecting the device to the vessel would complete the heating circuit with the battery.

Furthermore, although the non return valve in both embodiments opens and closes under its own weight it could also be in the form of a float or ball.

Furthermore, additional functionality could be added to the system such as a liquid crystal display to present information such as battery life, temperature of liquid or duration of feed.

If a rechargeable battery is preferred it could be recharged by placing the device on a charger stand or connecting to a car cigarette lighter socket.

The helix described in the specific description is removable and reusable after cleaning. The skilled man would understand the helix could be disposable and indeed may be manufactured and sold in a sterile polymer sheath or tube for insertion into the heated sheath 120. Additionally, the helix described in the specific description is only one example of a possible configuration of helix. As the helical path of the helix also controls the flow of liquid through the device, an alternative configuration, with an increased or decreased number of turns over the same length will give a different flow rate of liquid for a given applied suction or force. Other shaped inserts could be used other than a helix to perform the same function.

The heating means described with reference to the figures is heating elements or a wrap around wire. Alternatively the device could be heated by an exothermic chemical reaction or the heated sheath could be coated in a conductive spray and a 'wire' like arrangement etched out to create resistance and produce heat.

The device may be provided with a small pump formed and arranged to pump liquid through the heating means to the teat